MATH-MAZE

A Subject Based Yearly News Letter

LINEAR ALGEBRA

ISSUE - XIV (2020-2021)

Released by

π-MATH ASSOCIATION

PG DEPARTMENT OF MATHEMATICS

VELLALAR COLLEGE FOR WOMEN (Autonomous)

"College with Potential for Excellence"

(Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathiar University, Coimbatore)

Thindal, Erode - 638012, Tamil Nadu.

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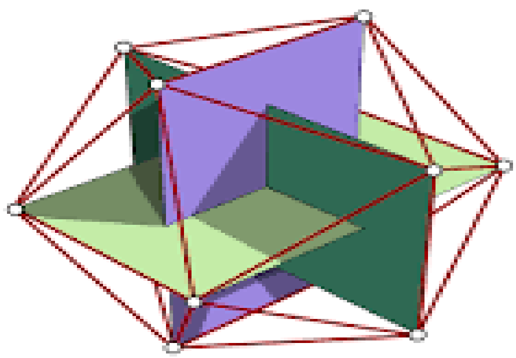
❖ Solutions to the above problems are invited, at the earliest. The names of the readers who turn out first in providing answers to the problems will be published and the solutions will be published in the forth coming issue.



FROM THE EDITORIAL DESK

The Department of Mathematics has been established in the year 2003. It offers B.Sc., Mathematics, M.Sc., Mathematics and M.Phil., Programme.

To its credit, the Department has organized, two National Seminars, two National Conferences, two Intercollegiate meet and an International seminar on 11^{th} & 12^{th} August 2005, 30^{th} & 31^{st} August 2007, 9^{th} January 2014, 9^{th} February 2017, 13^{th} September 2011, 24^{th} August 2018 and 10^{th} January 2018 respectively. It has celebrated National Mathematical Year on 24^{th} August 2012. In memory of Ramanujan's birthday Math Expo has been organized by the Department since 2013.

The Department is enriched with fifteen faculty members having wide knowledge in their specializations like Differential Equations, Fuzzy Set Theory, Intuitionistic Fuzzy Set, Graph Theory and Operations Research. The Department has completed two minor research projects funded by UGC and a student's funded projects funded by TNSCST. The Department has produced 56 M. Phil., Research Scholars from 2009 onwards.

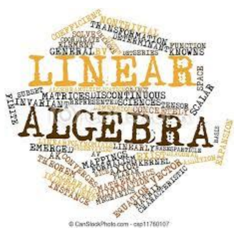
The Department adds one more feather by publishing a Subject Based Yearly News Letter incorporating History of Mathematicians, Crossword Puzzles, Cross out Puzzles, Solutions to the Problems of Previous issue, Departmental Activities and Placement details of the Students of Mathematics.

We welcome the suggestions and criticisms for improvement in the content and presentation of materials of "MATH-MAZE".

EDITORIAL DESK

HISTORY OF LINEAR ALGEBRA

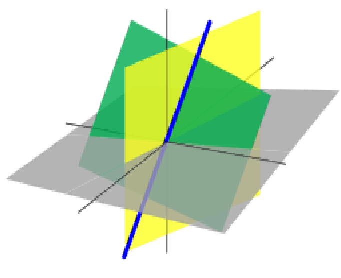
Linear algebra is one of the branches of mathematics and it facilitates the solution of linear system of differential equations by incorporating the linear equation as vector space through matrices. It is a study of lines, planes, vector spaces, polynomials, mappings, etc., that are required for linear transformations. Linear algebra is essential in analysis and applied mathematics. Its techniques are applied in Analytical geometry, Engineering physics, Natural sciences, Social sciences, Computer science, Computer animation, Machine learning, Deep learning and so on.



Linear algebra is also used in most sciences and fields of engineering, it allows modelling many natural phenomena and compute efficiently with such models.

Linear Algebra is a subfield of mathematics. Algebraic methods are authenticated in Egyptian, Babylonia, Sumerian and Chinese writings. Chinese writing shows practical procedures for solving systems of three equations since 1000 A.D. The people of Babylon solved a simple 2X2 system of linear equations around 4000 years ago with two unknowns. About 200 BC, Chinese published Nine Chapters of the Mathematical Art and displayed the ability to solve a 3X3 system of equations. The power and progress in linear algebra came to fruition during late 17^{th}century. Leibnitz, the founder of calculus, studied the connection of determinant and square matrix leads to the emergence of Linear Algebra. Lagrange introduced Lagrange multipliers to characterize the maxima and minima multivariate functions, few years later; Cramer presented his ideas of solving systems of linear equations based on determinants.

Euler brought to light the idea that a system of equations doesn't necessarily have a solution. He recognized the need for conditions to be placed upon the unknown variables in order to get a solution. The initial work until this period mainly dealt with the concept of unique solutions and square matrices where the number of equations matched the number of unknowns. Gauss introduced a procedure to solve a system of linear equations in19^{th} century; it mainly focuses on matrices or their notations. His efforts dealt with equations of differing numbers and variables as well as the traditional pre-19^{th}century works of Euler, Leibnitz, and Cramer.



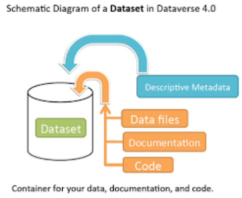
Gauss' work is later summed up in the term Gaussian elimination. This method uses the concepts of combining, swapping, or multiplying rows with each other in order to eliminate variables from certain equations. After determining the variables the back substitution method is employed to find the remaining unknown variables. Regardless of the technology, Gaussian elimination still proves to be the best way to solve a system of linear equations.

Solving systems of linear equations and transformation had great real-world application during World War II. Theories of matrix decompositions continue with the growing use of computers, linear algebra was relevant for solving practical problems in data storage and data manipulation.

Functions of Linear Algebra in various field

1. Dataset and Data Files

A data is a matrix or a data structure in Linear Algebra. A dataset contains a set of numbers or data in a tabular manner. Rows represent observations whereas columns represent features. Each row is of the same length and finally the data is vectorized. Rows are pre-configured and are inserted to the model one at a time for easier and authentic calculations.

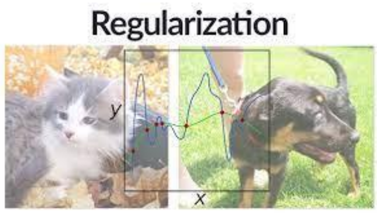


2. Images and Photographs

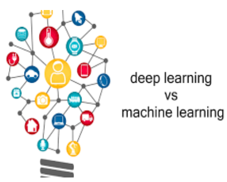
All images are tabular in structure. Each cell in black and white images comprises of height, width, and one-pixel value. Similarly, colour images have 3-pixel values in it apart from height and width. It forms a matrix in Linear Algebra. All kinds of editing such as cropping, scaling and manipulation techniques are performed using algebraic operations.

3. Regularization

Regularization is a method that minimizes the size of coefficients of data. Two common methods of implementation is used in regularization based on the measures of the magnitude of coefficients in a vector.



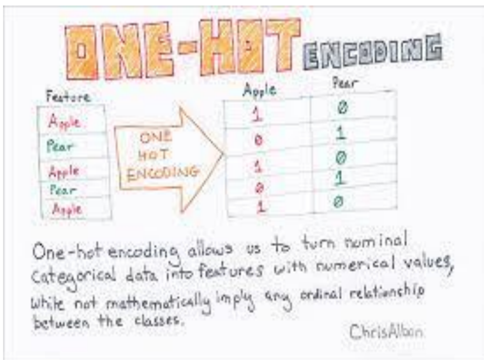
4. Deep Learning



This method is mostly used in neural networks with various real-life solutions such as machine translation, photo captioning, speech recognition and many other fields. It works with vectors, matrices, and even tensors as it requires linear data structures added and multiplied together.

5. One hot encoding

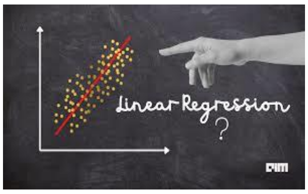
It is a popular encoding method for categorical variables for easier operations in algebra. A table is constructed with one column for each category and a row for each example. Digit 1 is added for categorical value succeeded by 0.



"Mathematics is the most beautiful and most powerful creation of the human spirit"

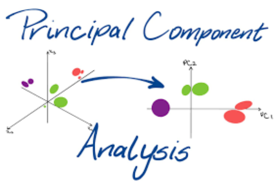
6. Linear regression

Linear regression is one of the statistical methods and it is used for predicting numerical values for regression problems as well as describing the relationship among variables using matrices.



Example: $y = A.b$ where A is dataset, b is constant and y is the output.

7. Principal Component Analysis(PCA)



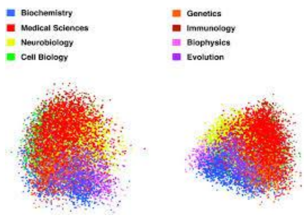
Principal Component Analysis is applicable while working with high-dimensional data for visualization and model operations. Matrix factorization plays a major role in PCA. When irrelevant data is found, then it would be tend to remove the redundant column(s) by using matrix factorisation method.

8. Single-Value Decomposition or SVD

It is also a matrix factorization method used generally in visualization, noise reduction, etc., SVD has broader use in Machine Learning (ML) from notation to the implementation of algorithms in datasets and images. With the help of ML, algebra has a larger impact in real-life applications such as search-engine analysis, facial recognition, predictions, computer graphics, etc., Few examples are given below.

i. Latent Semantic Analysis

In this process, documents are represented as large matrices for easy comparison of columns where rows represent words and columns represent documents. SVD is used to reduce the number of columns while preserving the similarity.

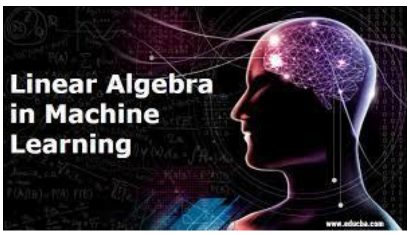


ii. Recommender Systems

Predictive models rely on the recommendation of products. With the help of Linear Algebra, SVD functions to purify data using Euclidean distance or dot products. For example, when purchases a book on Amazon, recommendations come based on purchase history keeping aside other irrelevant items.

9. Machine Learning

In Machine learning, Linear Algebra is used to create vector space and matrices to represent the linear equations for the implementation of algorithms and techniques in the code such as Regularization, Deep learning, One hot encoding, Principal Component Analysis, Single Value Decomposition, etc., These are used to describe the operations of the machine learning algorithm which acts as the key foundation in the field of machine learning



KNOW YOUR MATHEMATICIAN

Gottfried Wilhelm Leibniz

Gottfried Wilhelm (von) Leibniz (1 July, 1646 – 14 November, 1716) was a German polymath, active as a mathematician, philosopher, scientist, and diplomat. He is a prominent figure in both the history of philosophy and the history of mathematics. He works on philosophy, theology, ethics, politics, law, history and philology.

Leibniz made major contributions to physics & technology and anticipated notions that surfaced much later in probability theory, biology, medicine, geology, psychology, linguistics and computer science. He also contributed to the field of library science: while serving as overseer of the Wolfenbüttel library in Germany, he devised a cataloguing system that would have served as a guide for many of Europe's largest libraries.

Leibniz's contributions to this vast array of subjects were scattered in various learned journals, in tens of thousands of letters and in unpublished manuscripts. He wrote in several languages, primarily in Latin, French and German, but also in English, Italian and Dutch. As a philosopher, he was one of the greatest representatives of 17^{th}- century rationalism and idealism.

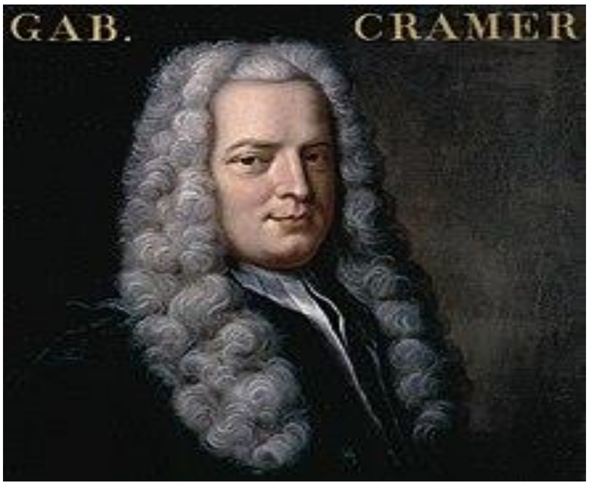
In 20^{th} century, Leibniz's law of continuity and transcendental law of homogeneity found a consistent mathematical formulation by means of non-standard analysis. He was a pioneer in the field of mechanical calculators.

"Obvious is the most dangerous word in mathematics"

While working on adding automatic multiplication and division to Pascal's calculator, he was the first to describe a pinwheel calculator in 1685 and invented the Leibniz wheel, used in the arithmometer, the first mass-produced mechanical calculator.

As a mathematician, his greatest achievement was the development of the main ideas of differential and integral calculus, independently of Isaac Newton's contemporaneous developments. Mathematical works have consistently favoured Leibniz's notation as the conventional expression of calculus.

Gabriel Cramer



Gabriel Cramer (31 July 1704 – 4 January 1752) was a Genevan mathematician. He was the son of physician Jean Cramer and Anne Mallet Cramer. Cramer showed obligation in mathematics from an early age. At 18 he received his doctorate and at 20 he was co-chair of mathematics at the University of Geneva.

In 1728, he proposed a solution to the St. Petersburg Paradox that came very close to the concept of expected utility theory given ten years later by Daniel Bernoulli.

He published his best-known work in his forties. This includes his treatise on algebraic curves (1750) it contains the earliest demonstration that a curve of the *n*-th degree is determined by $n(n + 3)/2$ points on it, in general position. This led to the mix - up that is Cramer's paradox, concerning the number of intersections of two curves compared to the number of points that determine a curve.

He edited the works of the two elder Bernoulli's and wrote on the physical cause of the spheroid shape of the planets and the motion of their apsides (1730) and on Newton's treatment of cubic curves (1746). In 1750 he published a standard rule named Cramer's rule, a general formula for the solution for any unknown in a linear equation system having a unique solution, in terms of determinants implied by the system.

He did extensive travel throughout Europe in the late 1730s, which greatly influenced his works in mathematics. He died in 1752 at Bagnols-sur-Cèze while travelling in southern France to restore his health.

"Mathematics allows for no hypocrisy and no vagueness"

LINEAR ALGEBRA – BASIC DEFINITIONS

VECTOR SPACE

A **Vector space** (or **linear space**) $\boldsymbol{V}$ over a field F consists of a set on which two operations (called **addition** and **scalar multiplication**, respectively) are defined so that for each pair of elements x, y in $\boldsymbol{V}$ there is a unique element $x + y$ in $\boldsymbol{V}$, such that the following conditions hold.

1. for all x, y in $\boldsymbol{V}$, $x + y = y + x$.
2. for all x, y, z in $\boldsymbol{V}$, $(x + y) + z = x + (y + z)$.
3. there exists an element in $\boldsymbol{V}$ denoted by 0 such that $x + 0 = x$ for each x in $\boldsymbol{V}$.
4. for each element x in $\boldsymbol{V}$ there exists an element y in $\boldsymbol{V}$ such that $x + y = 0$
5. for each element x in $\boldsymbol{V}$, $1x = x$
6. for each pair of elements a, b in $\boldsymbol{F}$ and each element x in $\boldsymbol{V}$, $(ab)x = a(bx)$.
7. for each element a in $\boldsymbol{F}$ and each pair of elements x, y in $\boldsymbol{V}$, $a(x + y) = ax + ay$.
8. for each pair of elements a, b in $\boldsymbol{F}$ and each element x in $\boldsymbol{V}$, $(a + b)x = ax + bx$.

LINEAR TRANSFORMATION

Let $\boldsymbol{V}$ and $\boldsymbol{W}$ be vector spaces (over F). We call a function $\boldsymbol{T}: \boldsymbol{V} \to \boldsymbol{W}$ a linear transformation from **V** to **W** if, for all $\boldsymbol{x}, \boldsymbol{y} \in \boldsymbol{V}$ and $\boldsymbol{c} \in \boldsymbol{F}$, we have

(a) $T(x + y) = T(x) + T(y)$
(b) $T(cx) = cT(x)$

BASIS

A basis $\boldsymbol{\beta}$ for a vector space $\boldsymbol{V}$ is a linearly independent subset of $\boldsymbol{V}$ that generates $\boldsymbol{V}$. If $\boldsymbol{\beta}$ is a basis for $\boldsymbol{V}$, then the vectors of $\boldsymbol{\beta}$ form a basis for $\boldsymbol{V}$.

LINEARLY DEPENDENT

A subset S of a vector space V is called **linearly dependent** if there exists a finite number of distinct vector $\mathrm{u}_1, \mathrm{u}_2, \dots\dots \mathrm{u}_n$ in S and scalars $a_{1,} a_2, \dots\dots a_n$ not all zero, such that

$$a_1 u_1 + a_2 u_2 + \dots\dots\dots + a_n u_n = 0$$

Then the vectors of S are linearly dependent.

LINEARLY INDEPENDENT

A subset S of a vector space that is not linearly dependent is called **linearly independent.** As before, we also say that the vectors of S are linearly independent.

"It is impossible to be a mathematician without being a poet in soul"

SUBSPACE

A subset W of a vector space V over a field F is called a **subspace** of V if W is a vector space over F with the operations of addition and scalar multiplication defined on V.

LINEAR COMBINATION

Let V be a vector space and S a nonempty subsets of V. A vector v in V is called a **linear combination** of vectors of S if there exist a finite number of vectors $u_1, u_2, \dots u_n$ in S and scalars $a_1, a_2, \dots a_n$ in F such that $v = a_1u_1 + a_2u_2 + \dots + a_nu_n$. In this case v is a linear combination of $u_1, u_2, \dots u_n$ and call $a_1, a_2, \dots a_n$ the **coefficients** of the linear combination.

ORDERED BASIS

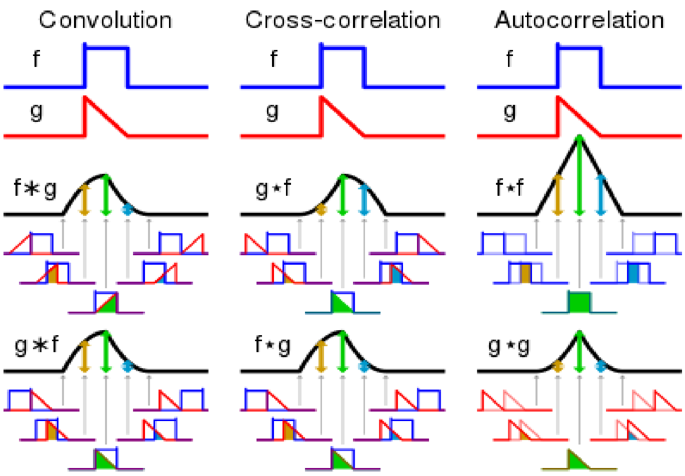
Let V be a finite-dimensional vector space. An **ordered basis** for V is a basis for V endowed with a specific order; that is, an ordered basis for V is a finite sequence of linearly independent vectors in V that generates V.

MATRIX REPRESENTATION

The m×n matrix A defined by $A = [a_{ij}]$, the **matrix representation of T in the ordering bases** β and γ and write $A = [T]_\beta^\gamma$.If $V = W$ and $\beta = \gamma$, then $A = [T]_\beta$.

CONVOLUTION

Convolution is a mathematical operation on two functions (f and g) that produces a third function $f * g$ that expresses how the shape of one is modified by the other. The term ***convolution*** refers to both the result function and to the process of computing.

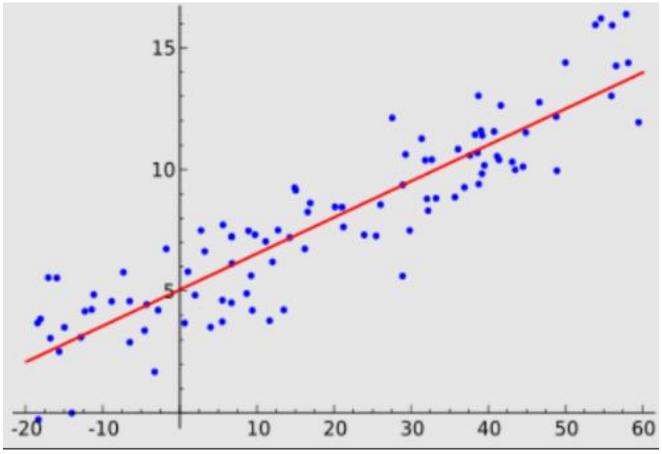


"Go down deep enough into anything and you will find mathematics"

LINEAR REGRESSION

Linear regression is a kind of statistical analysis that attempts to show a relationship between two variables. Linear regression looks at various data points and plots a trend line.

A regression model that gives a straight line relationship between two variables is called linear regression model.

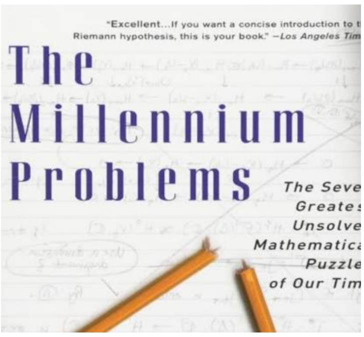


Regression is also a key ingredient of classification algorithms. To find a regression function it is required to solve a variety of problems, including the following:

- Choice of the model (type) and the parameterization of the regression function.
- Finding good parameters.
- Over fitting and model selection.
- Relationship between loss functions and parameter priors.
- Uncertainty modeling.

MILLENNIUM PRIZE PROBLEMS

Many mathematical problems have not been solved yet. These unsolved problems occur in multiple domains, including theoretical physics, computer science, algebra, analysis, combinatorics, algebraic, differential, discrete and Euclidean geometries, graph, group, model, number, set and Ramsey theories, dynamical systems, and partial differential equations. Some problems may belong to more than one discipline of mathematics. Among them one of the famous set of problems are millennium prize problems. The Millennium Prize Problems were seven unsolved problems in mathematics that were stated by the Clay Mathematics Institute on May 24, 2000. The problems are the Birch and Swinnerton-Dyer conjecture, Hodge conjecture, Navier–Stokes existence and smoothness, P versus NP problem, Poincaré conjecture, Riemann hypothesis, and Yang–Mills existence and mass gap. A correct solution to any of the problems results in a US$1 million prize being awarded by the institute to the discoverer.

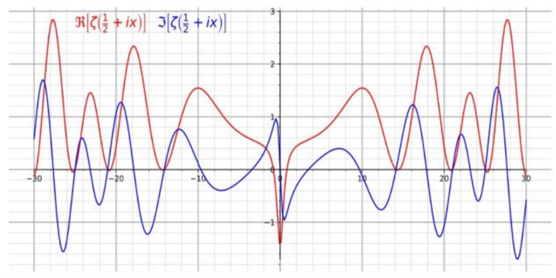


1. **Yang – Mills and Mass Gap**

Experiment and computer simulations suggest the existence of a "mass gap" in the solution to the quantum versions of the Yang-Mills equations.

2. **Riemann Hypothesis**

The prime number theorem determines the average distribution of the primes. The Riemann hypothesis tells us about the deviation from the average. Formulated in Riemann's 1859 paper, it asserts that all the 'non-obvious' zeros of the zeta function are complex numbers with real part ½.



3. **P vs NP Problem**

If it is easy to check that a solution to a problem is correct, is it also easy to solve the problem?. This is the essence of the P vs NP question. Typical of the NP problems is that of the Hamiltonian Path Problem: given N cities to visit, how can one do this without visiting a city twice?. This is the one of the most unsolved problem in graph theory.

4. **Navier–Stokes Equation**

This is the equation which governs the flow of fluids such as water and air. However, there is no proof for the solution of this equation. Still many mathematicians are trying to prove existence and uniqueness of solution for this equation.

5. **Hodge Conjecture**

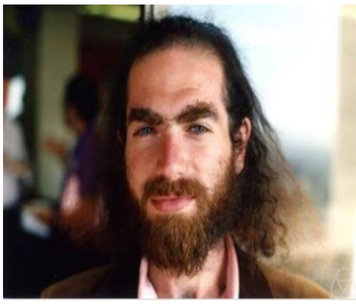
The answer to this conjecture determines how much of the topology of the solution set of a system of algebraic equations can be defined in terms of further algebraic equations. The Hodge conjecture is known in certain special case instance when the solution set has dimension less than four.

6. **Birch and Swinnerton-Dyer Conjecture**

Supported by much experimental evidence, this conjecture relates the number of points on an elliptic curve mod p to the rank of the group of rational points. Elliptic curves, defined by cubic equations in two variables, are fundamental mathematical objects that arise in many areas: Wiles' proof of the Fermat Conjecture, factorization of numbers into primes, and cryptography to name three.

7. **Poincaré Conjecture**

In 1904 the French mathematician Henri Poincaré asked if the three dimensional sphere is characterized as the unique simply connected three manifold. This question, the Poincaré conjecture, was a special case of Thurston's geometrization conjecture. Perelman's proof tells us that every three manifold is built from a set of standard pieces, each with one of eight well-understood geometries.



Up to date, the only Millennium Prize problem to have been solved is the Poincaré conjecture. During 2002 and 2003 Russian mathematician Grigori Perelman published three papers over the Internet that gave a “sketchy” proof of the Poincaré conjecture. His basic proof was expanded by several mathematicians and universally accepted as valid by 2006. That year Perelman was awarded a Fields Medal, but he refused.

“Life is a math equation. In order to gain the most, you have to know how to convert negatives into positives”

SCHOLARSHIPS FOR MATHEMATICS IN ABROAD

UK:

- **Commonwealth Master's Scholarship:** A scholarship from the University of Dundee for applicants from low- and middle-income Commonwealth countries to undertake a full-time master's program at a UK university. The scholarship covers one-year tuition fees, a monthly stipend, allowances package and travel costs.
- Edinburgh Global Undergraduate Mathematics Scholarships: Scholarships up to £5,000 (approximately US$6,350) per year are available to applicants from countries outside of the European Union. Students must have been accepted for a full-time admission to an undergraduate degree program offered by the School of Mathematics at the University of Edinburgh.

Italy:

- **TOPOLITO Scholarship:** Open to postgraduate international students studying at the Politecnico di Torino in Italy. Successful applicants will receive €8,000 per year (approximately US$9,150)

United States:

- **Fulbright Foreign Student Scholarship Program USA:** Open to international students studying masters or PhD programs who are applying to study at US universities.

Canada:

- **SCU International Women in STEM Scholarship**: This scholarship is available for female international students applying to study a full-time undergraduate or postgraduate degree in a STEM subject at Southern Cross University. Successful applicants will receive a US$8,000 fee reduction each year.

Australia:

- **International Merit Double Degree Scholarship**: Open to international students with an offer to study an undergraduate program at Queensland University of Technology in Australia, the scholarship will cover 25 percent of tuition fees for the first two semesters.
- **Australia Awards for International Students**: Successful applicants will receive full tuition fees, return air travel and contribution to living expenses from one of the participating universities in Australia. Applicants must be applying to study a masters level program and come from one of the participating countries.

New Zealand:

- **Roger Help Scholarship in Pure Mathematics:** The scholarship is available for students enrolled in a research master's degree or PhD degree in Mathematics at the University of Canterbury in New Zealand.

Japan:

- **Japanese Government (MEXT) Scholarships For Young Leaders Program:** Available for international students applying to master's courses at Japanese Successful applicants will receive a monthly stipend of 242,000 yen per month (approximately US$2260) to cover living expenses, accommodation, transportation and medical treatment.

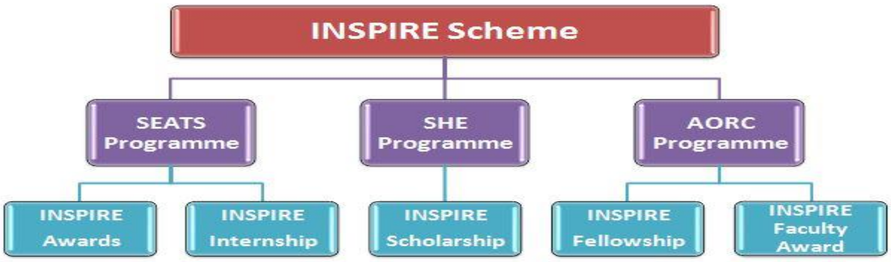
To study anywhere in the world:

- **Education Future International Scholarship:** This scholarship is open to Indian national students who are studying in a university outside of India. The value of the scholarship ranges between 2 Lakhs to 10 Lakhs (US$2,680-$13,400)
- **Joint Japan World Bank Graduate Scholarship Program:** For students who are undertaking master's level programs in development related topics (including applied mathematics) at a Japanese university, USA University or African university. Applicants must be a member of a World Bank member developing country to apply.

SCHOLARSHIPS FOR MATHEMATICS IN INDIA

INSPIRE Programme

Purpose: Ministry of Science & Technology offers this programme to candidates who want to pursue bachelor's as well as master's (level) education in natural or basic sciences. Innovation in Science Pursuit for Inspired Research (INSPIRE) has three components:



- **Scheme for Early Attraction of Talent (SEATS)** aims to attract talented students to study various subjects in the field of Science by providing an **INSPIRE Award** of Rs 5000 to one million young learners of the age group 10-15 years, ranging from Class VI to Class X standards, and also by arranging summer camps for about 50,000 science students of Class XI with global leaders in science to experience the joy of innovations on an annual basis through **INSPIRE Internship**.

- **Scholarship for Higher Education (SHE): SHE** aims to enhance rates of attachment of talented youth to undertake higher education in science-intensive programmes, by providing scholarships and mentorship. Every year 10,000 scholarship at Rs 80,000 per year are offered to talented youths in the age group 17-22 years, for undertaking Bachelor and Masters level education in natural sciences. The main feature of the scheme is the mentorship support provided to every scholar. Students who wish to pursue a course in B.Sc or M.Sc, can apply for the scholarship.

- **Assured Opportunity for Research Careers (AORC)** offers 1000 fellowships every year to students to aim to pursue a course in the research department and for carrying out a doctoral degree in both basic and applied sciences including engineering and medicine. In the second component i.e., **INSPIRE Faculty Scheme**, it offers assured opportunity every year for 1000 post-doctoral researchers in the age group of 27-32 years, through contractual and tenure track positions for 5 years in both basic and applied sciences area.

Scholarship Amount: Rs 80,000 annually (Higher Studies)

Narotam Sekhsaria Scholarship Programme

Purpose: Narotam Sekhsaria Foundation offers interest-free loan scholarships to students who want to pursue PG courses in fields like Applied Sciences, Pure Sciences, Social Sciences and Humanities, Architecture Law, and Management at good Indian as well as international universities.

Scholarship Amount: Maximum Rs 20 Lakhs

HDFC Educational Crisis Scholarship Support (ECSS)

Purpose: To provide support to students whose families are facing personal/economic crisis such that they can pursue their education without any hurdles.

Scholarship Amount: Rs 10,000 to Rs 25,000 per annum

Kishore Vaigyanik Protsahan Yojana (KVPY)

Purpose: Government of India’s Department of Science and Technology offers this scholarship to encourage students to pursue a career in Science research.

Scholarship Amount: Rs 5000 per month or Rs 20,000 annual contingency grant for 3 to 5 years to UG level candidates. Postgraduate aspirants are offered scholarship worth Rs 7000 per month or Rs 28,000 annual contingency grant.

Post-Graduate Merit Scholarship for University Rank Holders

Purpose: Aspirants are offered this scholarship to promote higher education in India. Candidates who secure this scholarship can pursue their post-graduation studies in any specialisation from any higher education institute in India.

Scholarship Amount: Rs 3,100 per month for the duration of two years.

Women Scientist Scheme (WOS-A)

Purpose: Department of Science and Technology offers this scholarship to encourage women scientists as well as technologists to pursue research in basic/applied sciences.

Scholarship Amount: As part of this scheme, aspirants are awarded a research grant such that for Ph.D holders or equivalent candidates the maximum amount granted is Rs 30 lakhs and for M.Sc or equivalent the maximum grant amount is Rs 20 lakhs. The amount is awarded for a maximum duration of three years.

Mathematics Training and Talent Search Programme (MTTS)

Purpose: Candidates are awarded assistance to promote the idea of studying and developing independent mathematical thinking.

Scholarship Amount: The programme is free of cost wherein aspirants are offered travel allowance, certificates and cash prizes.

AcSIR Dr APJ Abdul Kalam Summer Training Programme

Purpose: As part of this programme, aspirants are provided with an opportunity to work at premier research Laboratories of CSIR during the summer months (May to August).

Scholarship Amount: Candidates are awarded Rs 25,000 for the programme duration. Selected students are also given travel allowance such that it does not exceed Rs 5,000. The amount is paid to aspirants after they complete their training programme and submit their project report to Lab Coordinator.

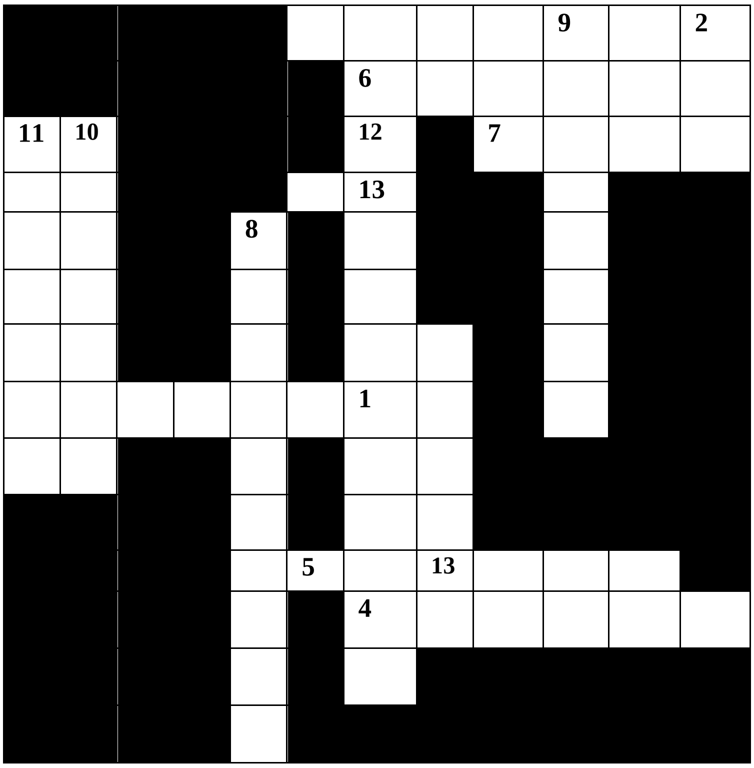
IAS Bangalore notifies Summer Research Fellowship

Purpose: As part of this fellowship, aspirants can work with scientists associated with Indian National Science Academy, New Delhi; Indian Academy of Sciences, Bengaluru and The National Academy of Sciences, Allahabad. Candidates who have a science degree at UG or PG level can apply(October to November through official website of IAS Bangalore.).

IGCAR JRF

Purpose: Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam offers Junior Research Fellowship to candidates who want to do research work in areas such as physical, chemical as well as engineering sciences.
Scholarship Amount: Rs 16,000 per month

CROSS WORD PUZZLES



RIGHT TO LEFT:

1. _______ learning focuses more on the concepts of Linear Algebra as it serves as the main stage for all the complex processes.
2. Some people consider linear _______ is the back bone of machine learning and Data science.
3. Machine learning is a division of_______ that focuses on building applications by processing available data science and machine learning to help without human intervention.

LEFT TO RIGHT:

4. Gabriel Cramer used them for giving explicit solutions of linear systems, called _________rule.
5. The simplest functional relationship between inputs and outputs is_______ Relationship when $y = mx + c$.
6. Using the_______ operations (set of rules), we can solve for the values of x and y in the blink of an eye.
7. _______ science is generally considered as the prerequisite to machine learning.

UP TO DOWN:

8. The linear equation, you can understand the workings of a_______ and hence the basics of a neural network.

9. The cos *t* function of the _______ descent is given as:

$$J = \sum_{i=1}^{n} \frac{(mX_i + c - Y_i)^2}{n}$$

10. _______ in machine learning can help you save money on marketing initiatives by reducing waste.

11. Linear Algebra as it serves as the main stage for all the _______ processes to crunch numbers.

12. In _______ machine learning is a best role in Linear Algebra to found the answers in several questions.

DOWN TO UP:

13. Using computational libraries like _______ makes much more sense instead of testing your stamina.

"The study of mathematics, like the Nile, begins in minuteness but ends in magnificence"

CROSS OUT CROSSWORD PUZZLES

N	A	I	B	O	C	A	J	H	O	M	O	G	E	N	E	O	U	S	E	T
S	L	A	Y	E	U	L	E	R	C	O	V	A	R	I	A	T	I	E	S	R
Q	G	M	D	J	R	E	N	O	I	T	I	D	N	O	C	E	R	P	H	I
U	B	G	E	N	I	F	F	U	R	T	E	B	A	S	H	A	P	E	S	A
A	O	I	H	S	O	R	E	R	D	Q	W	S	D	E	C	O	D	E	R	N
R	K	S	W	I	A	B	D	U	C	T	I	O	N	C	R	I	C	L	E	G
C	H	O	L	E	S	K	Y	F	A	C	T	O	R	I	Z	A	T	I	O	N
E	S	T	H	Q	U	E	C	O	N	D	O	R	D	E	R	F	I	R	S	L
T	P	N	E	M	P	S	E	L	B	A	I	R	A	V	L	A	M	I	R	P
N	E	E	S	T	A	V	A	L	I	D	A	T	I	O	N	S	E	T	N	E
E	C	N	S	E	I	Q	S	E	T	F	U	N	T	I	O	N	K	D	J	T
I	T	O	I	R	S	W	A	P	P	I	N	G	O	U	T	P	U	T	O	J
D	R	P	A	U	T	E	S	N	O	I	T	A	R	G	E	T	N	I	P	I
A	A	X	N	Q	O	N	O	I	T	A	G	A	P	O	R	P	K	C	A	B
R	L	E	N	S	M	P	R	E	C	O	N	D	I	T	I	O	N	E	R	O
G	M	N	O	I	T	A	G	A	P	O	R	P	E	T	I	N	I	F	N	I
O	N	I	O	N	S	F	N	O	I	T	A	Z	I	R	A	L	U	G	E	R

1. Two rows/columns changes the sign of $det(A)$ is_______
2. _______provides a square root equivalent operation on symmetric, positive definite matrices that is useful in practice.
3. The generalization of the derivative to functions of several variables is _______
4. The collection of all first-order partial derivatives of a vector-valued function $f : Rn \to Rm$ is _____
5. Automatic Differentiation turns out_______
6. _________is the collection of all second-order partial derivatives.
7. The set choosing for the best model is _________
8. To mitigate the effect of over fitting by penalizing the amplitude of regularization the parameter by means of__________
9. ________ states that there exists no algebraic solution to this problem for polynomials of degree 5 or more.

"Mathematics consists of proving the most obvious thing in the least obvious way."

10. The mapping from the code back to the original data space is called the ___________

11. In optimization is the idea of converting an optimization problem in one set of variables x_______

12. These transformations are extremely relevant in machine learning in the context of training deep neural networks using the reparametrization trick infinite__________

13. The Eigen decomposition underlies a general class of machine learning algorithms called ______

14. In philosophy, this is considered to be neither induction nor deduction, but it is called ______

15. For the purposes of this book, we assume that a domain expert already converted data appropriately, i.e., each input x_n is a D −dimensional vector of real numbers, which are called______

16. Instead of directly solving $Ax = b$, one could instead solve $P - 1(Ax - b) = 0$, where P is called _______

"Mathematics may not teach us to add love or subtract hate, but it gives us hope that every problem has a solution"

SOLUTIONS TO THE PROBLEMS OF THE PREVIOUS ISSUE

CROSSWORD PUZZLESS – TOPOLOGY

RIGHT TO LEFT

6.Subspace

14.Connected

15.Open

LEFT TO RIGHT

1.Separable

3.Order

4.Closed

5.Lindelof

7.Linear

8.Topological

9.Normal

12.Connected

13.Bicompact space

UP TO DOWN

2.Baire

11.Projections

DOWN TO UP

10.Isolated

CROSS OUT CROSSWORD PUZZLES

1. Regular

2.Baire

3. Set

4.Clopen

5. Closed

6. Compact

7. Convergent

8. Isolated

9. Complement Closure

10. Countable

11. Limit

12.Lindelof

13. Metric

14. Cauchy

15. Zero

CONGRATULATIONS

Congratulations to the following readers who turn out first in providing answers to the problems of the previous issue:

CROSS WORD PUZZLE

T. Preethi (II-M. Sc., Maths ‘B’)

R. Mythili (II-M. Sc., Maths ‘B’)

CROSS OUT PUZZLE

S. Dharani (II-M. Sc., Maths ‘A’)

T. Sabari Ishwarya(II-M. Sc., Maths ‘B’)

K. K. Sowmeyasree (II-M. Sc., Maths ‘B’)

DEPARTMENT ACTIVITIES

- As a part of Bridge Course, the fresher's were acquainted with "**Fundamentals of Mathematics"** on 11.09.2020. The aim of the entry level test is to enable them to cope with the transform from school to college level. Basic skills of students were tested through entry level test conducted through online, which carries questions from the topics Trigonometry, Differentiation and Integration, Statistics, Complex Analysis and Vector Analysis. 108 students were benefited in this Bridge Course.
- The PG Department of Mathematics organized a *Webinar on* ***'Career Challenges and progress'***on 10th July 2020, Ms. **Mounica Rajagopal, M.Tech.,** Quality Analyst, Wipro,enlighten the skills in occupational exploration and career planning. They identify appropriate behaviors to functioning effectively in career and social environments. Final year PG students of our department were benefited in this Webinar.
- The PG Department of Mathematics have organized a *Webinar on* ***'Applications of Mathematics in Cryptography'*** on 13th August 2020, **Ms. Lourdhu Jannet Vinoli X**, Associate Professor, Department of Mathematics, Indian Academy Degree College – Autonomous, Bangalore enlightened the mathematical concepts behind the security protocols for protecting information on networks. Students interacted in the session and raised their doubts. They obtain authentication and confidentiality in the information and communication from unauthorized revelation.
- The Department of Mathematics organized an Online Virtual Math Expo on 22.12.2020, **133rd Srinivasa Ramanujan's Birthday**. **Dr. R. Parvathi,** Associate Professor and Head, Vellalar College for Women inaugurated the Math Expo. **Dr. S. Karthikeyan**, Associate Professor and Head, Erode Arts and Science College gave an enlightening talk about Ramanujan's aggregate.
- The PG Department of Mathematics and Mathematical Space, Delhi jointly organized a National level *Webinar on* ***'Career in Mathematics'*** on 16th February 2021, **Ms. Neha Upadhyay, Founder, Mathematical Space, Delhi** motivated the students to plan their career in the field of Mathematics. They acquired knowledge to apply their innovative ideas in various sectors. Final year UG & PG students of our department and 67 outside participants were benefited in this Webinar.

- The PG Department of Mathematics organized a Webinar on **“Financial Awareness”** on 23.03.2021 through online mode. **Dr.P.Karthikeyan,** Associate Professor, School of Management Studies, Kongu Engineering College, to create awareness regarding financial literacy and goal of financial literacy which will help in understanding financial concepts that will be helpful for them to manage their money better.

- **Association Competitions** like Math Connection, Puzzles, e-invitation making and PPT, were conducted by the Department of Mathematics on 30.03.2021to activate the interest of the students.

STUDENT ACTIVITIES

Paper presented in Seminar / Conference / Workshop / Symposium

<table>
<tr><th>S. No</th><th>Name & Class</th><th>Title of Seminar/ Conference/ Workshop/ Symposium</th><th>Organizer</th><th>Title of the Paper</th><th>Date(s)</th></tr>
<tr><td>1</td><td>T. Harini(I BSc Mathematics ‘A’)</td><td>Virtual Math Expo 2020</td><td>Vellalar College for Women, PG Dept of Mathematics</td><td>Measurements in daily life</td><td>22.12.2020</td></tr>
<tr><td>2</td><td>K.Legasri
(I BSc Mathematics ‘A’)</td><td>Virtual Math Expo 2020</td><td>Vellalar College for Women, PG Dept of Mathematics</td><td>Ramanujan's contribution towards mathematics</td><td>22.12.2020</td></tr>
<tr><td>3</td><td>E. Abirami
(II M.SC Maths A)</td><td>International Conference on Dynamical System and Soft Computing (ICDSSC - 2021)</td><td>Gobi Arts and Science College, Gobi</td><td rowspan="2">Application in Fluid Dynamics</td><td rowspan="2">05.03.2021-06.03.2021</td></tr>
<tr><td>4</td><td>V. Harshinipriya
(II M.SC Maths A)</td><td>International Conference on Dynamical System and Soft Computing (ICDSSC - 2021)</td><td>Gobi Arts and Science College, Gobi</td></tr>
<tr><td>5</td><td>M. Gayathri
(II M.Sc Maths A)</td><td>International Conference on Dynamical System and Soft Computing (ICDSSC - 2021)</td><td>Gobi Arts and Science College, Gobi</td><td rowspan="2">Introduction to Image Processing</td><td rowspan="2">05.03.2021-06.03.2021</td></tr>
<tr><td>6</td><td>M.Narmatha
(II M.Sc Maths A)</td><td>International Conference on Dynamical System and Soft Computing (ICDSSC - 2021)</td><td>Gobi Arts and Science College, Gobi</td></tr>
<tr><td>7</td><td>M. Dharanya
(II M.Sc Maths A)</td><td>International Conference on Dynamical System and Soft Computing (ICDSSC - 2021)</td><td>Gobi Arts and Science College, Gobi</td><td rowspan="2">An Introduction to Control theory with applications to Computer Science</td><td rowspan="2">05.03.2021-06.03.2021</td></tr>
<tr><td>8</td><td>M. Mathumitha
(II M.Sc Maths A)</td><td>International Conference on Dynamical System and Soft Computing</td><td>Gobi Arts and Science College, Gobi</td></tr>
</table>

		(ICDSSC - 2021)			
9	B. Niveda (II M.Sc Maths A)	International Conference on Dynamical System and Soft Computing (ICDSSC - 2021)	Gobi Arts and Science College, Gobi	Discussion on Optimization Techniques	05.03.2021-06.03.2021
10	P. Kiruthika (II M.Sc Maths A)	International Conference on Dynamical System and Soft Computing (ICDSSC - 2021)	Gobi Arts and Science College, Gobi		
11	P. Karthikaa (II M.Sc Maths A)	International Conference on Dynamical System and Soft Computing (ICDSSC - 2021)	Gobi Arts and Science College, Gobi	Application of Fuzzy set theory	05.03.2021-06.03.2021
12	S. Arunaa (II M.Sc Maths A)	International Conference on Dynamical System and Soft Computing (ICDSSC - 2021)	Gobi Arts and Science College, Gobi		
13	B. Thilagavathi (II M.Sc Maths B)	International Conference on Dynamical System and Soft Computing (ICDSSC - 2021)	Gobi Arts and Science College, Gobi	Cryptography and its Applications	05.03.2021-06.03.2021
14	R. Vindhiya (II M.Sc Maths B)	International Conference on Dynamical System and Soft Computing (ICDSSC - 2021)	Gobi Arts and Science College, Gobi		

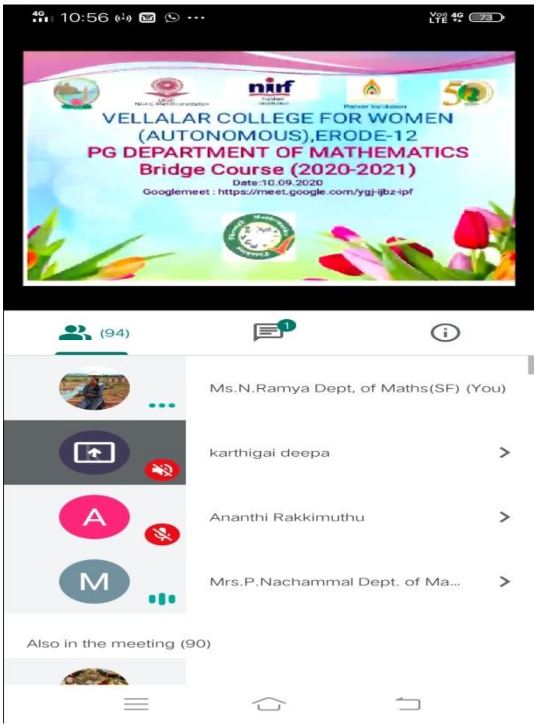
STUDENTS ACHIEVEMENT

S. No	Name and Class of the student	Event/ Programme	Date	Organizer	Award/ Prize/ Position
1	R. Dharunya (I M.Sc Maths A)	8^{th} State level Virtual Intercollegiate Math Fest CENTRA – 2K20	21.12.2020	Sankara College of Science and Commerce	First Prize

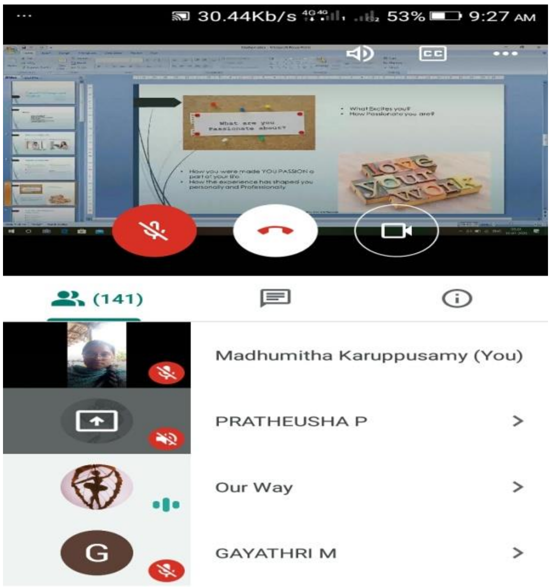
Placement Details

S. No	Name of the Student	Class	Company Name
1	A. M. Logida	III B.Sc Maths A	Cognizant
2	S. Deepasri	III B.Sc Maths A	TCS

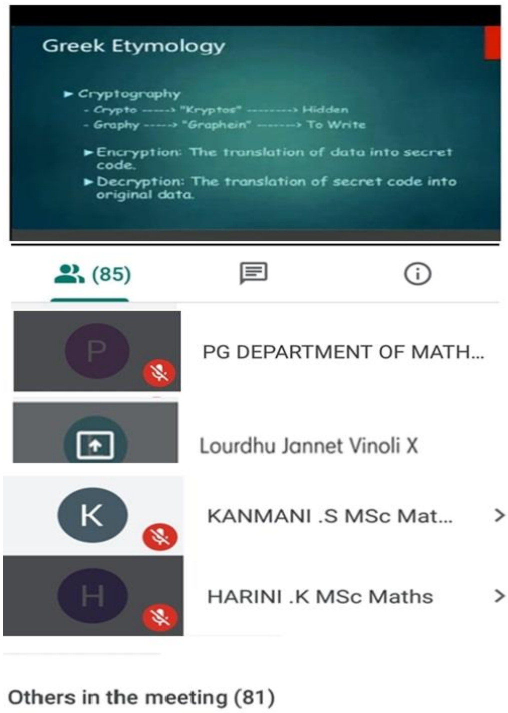
SNAP SHOT



Bridge Course for the UG first year students on **"Fundamentals of Mathematics"** to fill the hiatus in learning on 11.09.2020.

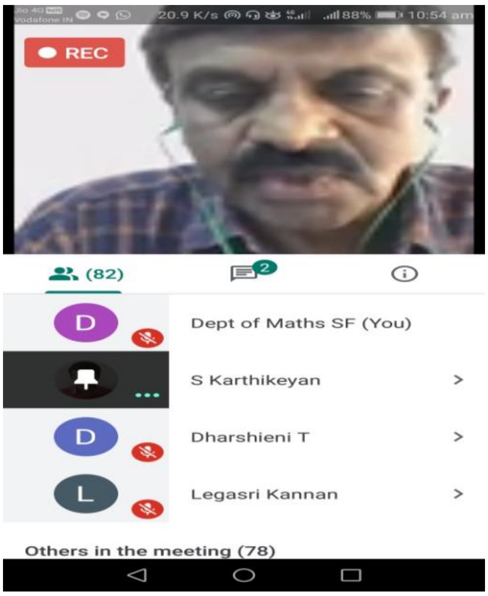


Webinar on **"Career Challenges and Progress"** by Ms. Mounica Rajagopal on 10.07.2020.

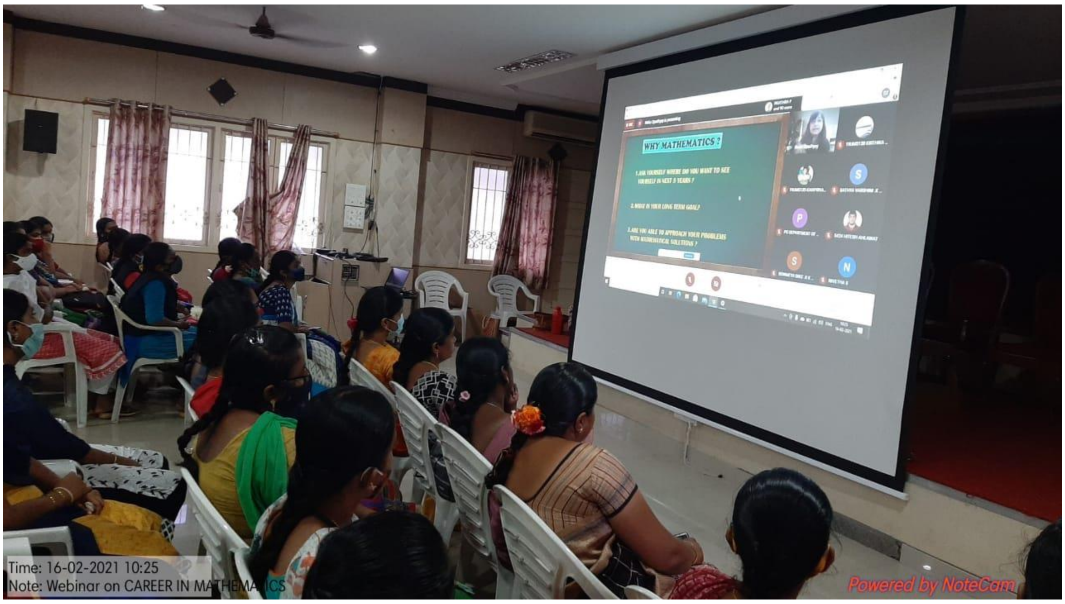


Webinar on **"Applications of Mathematics in Cryptography"** by

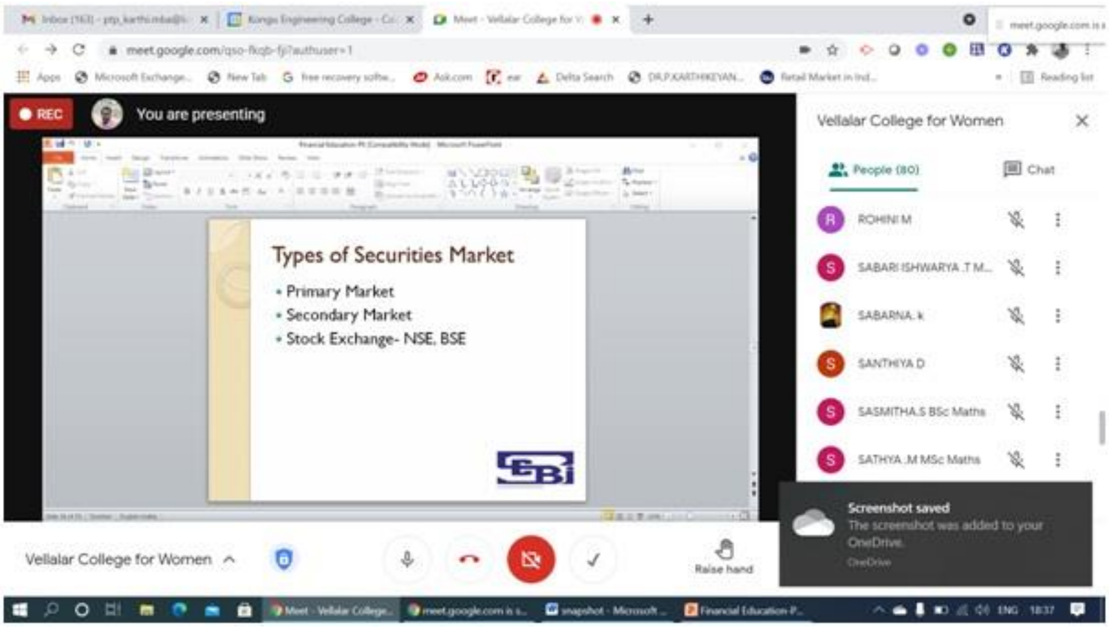
Ms. Lourdhu Jannet Vinoli X on 13.08.2020.



"Online Virtual Math Expo" organized on 22.12.2020, Dr.S.Karthikeyan felicitated.



Webinar on **"Career in Mathematics"** by Ms. Neha Upadhyay on 16.02.2021.



Webinar on **"Financial Awareness"** by Dr.P.Karthikeyan on 23.03.2021.